SECTION 6
PROOF-OF-CONCEPT RESULTS

6.1 INTRODUCTION

In the preceding section of this report, five hypothetical replacement resource alternatives were identified to demonstrate the methods, tools, and techniques for resource evaluation and acquisition. These resource alternatives illustrate the varying characteristics of replacement power arrangements that Western may encounter in its Replacement Resources Process, including alternative pricing structures, alternative capacity commitments (seasonal, monthly, unit purchase), and differing points of delivery to Western's system. The replacement resources were then analyzed using a levelized-cost screening tool to demonstrate the screening process which Western will use to reduce the number of alternatives selected for the integrated analysis.

For the proof-of-concept analysis, the detailed integrated system analysis was prepared for all of the replacement alternatives. First, a base case model was prepared, representing the interconnected system with no replacement power resource. Then, integrated analysis cases were prepared for each of the five replacement resource alternatives, assuming all SLCA/IP customers take their proportionate share of the WRP resource.

The integrated analysis of the replacement resource alternatives involves a simulation of the economic scheduling of resources to serve load over the entire integrated system modeled for each hour (i.e., 8,760 hourly simulations of a very complex system to simulate all of the hours in one year). For the proof-of-concept analysis, a typical week was used to represent each month. In addition, the base case and WRP Alternative 1 were evaluated for each of the five years in the study period (1996-2000), while the other alternatives were evaluated only for the years 1996 and 2000.[1] A linear approximation was used to interpolate values for the years not modeled.

The results of the integrated analysis presented in this section illustrate the evaluation process, demonstrate the use of the modeling tools, and confirm that the recommended analysis produces reasonable results.[2] Presentation of the results in several formats aids in evaluation, and demonstrates the range of criteria that can be used to compare the alternatives, as well as the ability of the modeling tools to accommodate the varying needs of Western and its diverse customer base.

The economic impact of the replacement resource on SLCA/IP customers is presented first. This information is then used to develop an adjusted levelized-cost analysis as a revision to the screening analysis shown in Section 5. The levelized-cost information is presented in both tabular form and graphically in the form of cost curves. Finally, a sample rate analysis is provided to illustrate a rate impact calculation for customers purchasing WRP. At the end of this section, findings based on the proof-of-concept analysis are presented.

6.2 RESULTS OF INTEGRATED ANALYSIS

The integrated analysis results are summarized on Table 6-1 below. The purpose of the integrated analysis was to determine the net effect that the WRP alternative has on the operation of the integrated system. Therefore, the results are presented as the difference between each alternative and the base case, with positive figures indicating that the alternative has a higher cost than the base case.

TABLE 6-1

COST OF REPLACEMENT RESOURCE ALTERNATIVES *

(ANNUAL COST IN $1,000'S)

	1996	1997	1998	1999	2000
Alternative 1: Seasonal Block Purchase @Craig					
SLCA/IP Customers Purchasing WRP:					
Direct Costs (or Savings)	$11,050	$8,223	$4,171	$5,546	$4,757
Indirect Costs (or Savings)	(6,803)	(7,055)	(7,713)	(9,842)	(12,583)
Total	$4,247	$1,168	($3,542)	($4,295)	($7,826)
Alternative 2: Seasonal Block Purchase @Pinnacle Peak					
SLCA/IP Customers Purchasing WRP:					
Direct Costs (or Savings)	$11,216	$11,402	$11,592	$11,784	$11,980
Indirect Costs (or Savings)	(1,570)	($1,268)	($1,024)	($827)	(668)
Total	$9,646	$10,135	$10,568	$10,958	$11,312
Alternative 3: Monthly Energy Purchase @Shiprock-Four Corners					
SLCA/IP Customers Purchasing WRP:					
Direct Costs (or Savings)	$17,059	$17,215	$17,372	$17,531	$17,691
Indirect Costs (or Savings)	(11,540)	($13,606)	($16,042)	($18,913)	(22,299)
Total	$5,519	$3,609	$1,330	($1,383)	($4,608)
Alternative 4: Capacity/Energy Exchange @PacifiCorp-Eastern Division					
SLCA/IP Customers Purchasing WRP:					
Direct Costs (or Savings)	($1,546)	($1,856)	($2,228)	($2,675)	($3,212)
Indirect Costs (or Savings)	3,818	$2,184	$1,250	$715	409
Total	$2,272	$328	($979)	($1,960)	($2,803)
Alternative 5: Wind Project Purchase @Craig					
SLCA/IP Customers Purchasing WRP:					
Direct Costs (or Savings)	$18,725	$18,009	$17,320	$16,657	$16,020
Indirect Costs (or Savings)	(5,331)	($6,305)	($7,456)	($8,818)	(10,429)
Total	$13,394	$11,704	$9,863	$7,839	$5,591

* Shaded area represents interpolated numbers.

For the proof-of-concept analysis, all SLCA/IP customers were assumed to purchase a proportional share of WRP, which may not occur in the actual replacement resource analyses that Western prepares. To illustrate the effect of the WRP resource on all SLCA/IP customers, the presentation could be modified to show the effect on SLCA/IP customers not participating in WRP.

For each alternative, the SLCA/IP customer total cost (or savings, represented by negative numbers) compared to the base case are calculated as the sum of the direct costs to SLCA/IP customers, plus indirect costs (or savings) resulting from transactions with other utilities.

The direct costs for SLCA/IP customers include the fixed costs of the WRP alternative, the energy cost of WRP scheduled directly by SLCA/IP customers, and the change in the annual energy cost of SLCA/IP customer-owned resources compared to the base case. The fixed costs for WRP alternatives include both the capacity cost and any costs associated with minimum scheduling requirements.[3]

To determine the indirect cost or savings from transactions with other (non-SLCA/IP) utilities, the difference in operation of all resources was calculated by comparing the results of each WRP resource alternative to the base case. The difference in operation of SLCA/IP customer-owned resources represents WRP scheduled by SLCA/IP customers which displaced their own resources.[4] The difference in operation of resources owned by other utilities represents surplus WRP marketed to other utilities. When WRP economically displaces generation from other utilities' resources, WRP sales were assumed to be priced at a split-the-savings rate between the cost of WRP and the decremental cost of the affected resources. Both Alternative 1 and Alternative 2 demonstrate the capability of the model to show a WRP alternative economically displacing energy from other utility resources.[5]

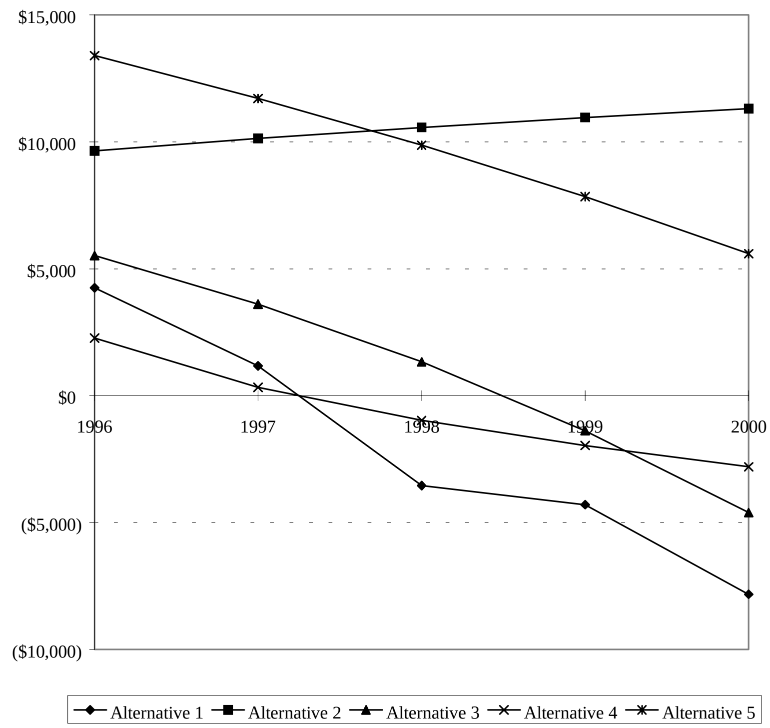
For the alternatives in which non-economic scheduling of surplus WRP was necessary to meet purchase restrictions or contract commitments (such as minimum scheduling levels), surplus WRP was marketed to the other utilities. An example of minimum scheduling requirements of the WRP resulting in a "forced" sale of surplus WRP to other utilities was demonstrated in Alternatives 3, 4, and 5.[6]

For illustrative purposes, the results of the integrated analysis are presented in Figure 6-1 below, with the relative cost of each alternative compared to the base case.

FIGURE 6-1

COST OF REPLACEMENT RESOURCE ALTERNATIVES

(ANNUAL COSTS IN $1,000'S)



In the first two years of the analysis, Alternative 4 has the lowest cost. By 1998, the economics of Alternative 1 improve, and Alternative 1 is the lowest cost through the end of the analysis. Additionally, all of the alternatives (except Alternative 2) show reduced costs (or increasing savings) over the study period as compared to the base case. This is due, in part, to the increasing cost of spot-market purchases in the base case, as the capacity surplus on the WSCC system is reduced, causing resources with higher energy costs to serve deficits. The cost of Alternative 2 increases through the analysis because the energy cost of the alternative is based on the incremental energy cost of a specific utility, which is projected to increase along with the non-firm market price.[7]

6.2.1 INTERPRETATION OF RESULTS

In the base case, the resource deficit of the SLCA/IP customers is filled by spot-market energy purchases. This would be expected to be a low cost strategy for the short-term, but does not provide the guarantee of available power during peak hours, or the price of this power if available. All of the resource replacement alternatives provide greater certainty of power availability and cost than the base case, and would therefore be expected to be more expensive than the base case, at least in the short-term.

This expectation was borne out by the analysis results, as summarized in the chart above, which show that all of the WRP alternatives are more expensive than the base case in the first few years. This represents the “cost” of the greater certainty provided by acquiring a replacement resource, compared to relying on the spot-market.

In addition to the cost results presented above, Western can use other results from the integrated analysis in their decision making process. For example, the model reports effects on the transmission system on hourly, monthly, or annual basis. Western can identify the number of hours when transmission transactions are scheduled at the defined maximum capacity of a path, or the amount of energy scheduled across a particular path for a particular time period. Detailed results of the economic dispatch, resource operation, and other system output can also be used where necessary to clarify overall results or study specific situations.

6.3 UPDATE OF LEVELIZED-COST ANALYSIS

The fourth step of the proposal evaluation process reviewed at the beginning of Section 5 is:

Step 4: Re-rank the proposals based on levelized, per-unit cost to SLCA/IP customers using the results from Step 3.

In the screening analysis described in Section 5.5, the revenues for marketing off-peak energy were estimated based on a simplified representation of the non-firm market.[8] The integrated analysis simulated the interaction of each WRP alternative in the interconnected bulk power system of the Rocky Mountain and Desert Southwest areas of the WSCC region. The results of the integrated analysis were incorporated into the initial levelized-cost (screening) analysis to provide an improved estimate of both the level and value of energy sales of WRP to other utility systems.[9]

The adjusted levelized-cost analysis is summarized in the table below.[10] A lower levelized cost in this adjusted analysis indicates that the net revenues from sales of WRP to other utility systems determined from the integrated analysis was greater than the estimate used in the screening analysis. For some alternatives, the uneconomic operation of the resource due to minimum energy scheduling requirements resulted in an increase in levelized costs as compared to the base case.

TABLE 6-2

ADJUSTED LEVELIZED-COST ANALYSIS

	Alternative 1 Firm Capacity Block	Alternative 2 Firm Capacity Block	Alternative 3 Firm Energy	Alternative 4 Capacity Exchange	Alternative 5 Non-dispatchable Wind
Capacity Maximum (MW)	491	491	491	491	200
Capacity Average (MW)	434	434	227	227	100
On-Peak Capacity Factor					
Maximum	100%	100%	100%	100%	57%
Minimum	0%	0%	88%	60%	38%
Capacity Factor	**Levelized Per Unit Cost (mills per kWh)**				
10%	96.07	89.94			
20%	50.85	56.46			
30%	35.78	45.69			
40%	28.24	40.31			91.06
50%	23.74	37.08			86.37
60%	21.90	35.02		25.90	83.71
70%	21.32	33.66		25.28	
80%	21.28	32.69		24.63	
90%	21.59	31.97	31.72	23.97	
100%	22.15	31.44	30.48	23.31	

In general, the results from the levelized-cost analysis show that Alternatives 1 and 4 are the lowest cost options, Alternatives 2 and 3 provide the next lowest cost, and Alternative 5 is the most expensive option. Results from the integrated analysis discussed above in Section 6.2 could be used to determine the ranking between alternatives that have a relatively close levelized cost (such as Alternatives 1 and 4, or Alternatives 2 and 3).[11]

6.4 COST CURVE PRESENTATION

The fifth step of the proposal evaluation process reviewed at the beginning of Section 5 is:

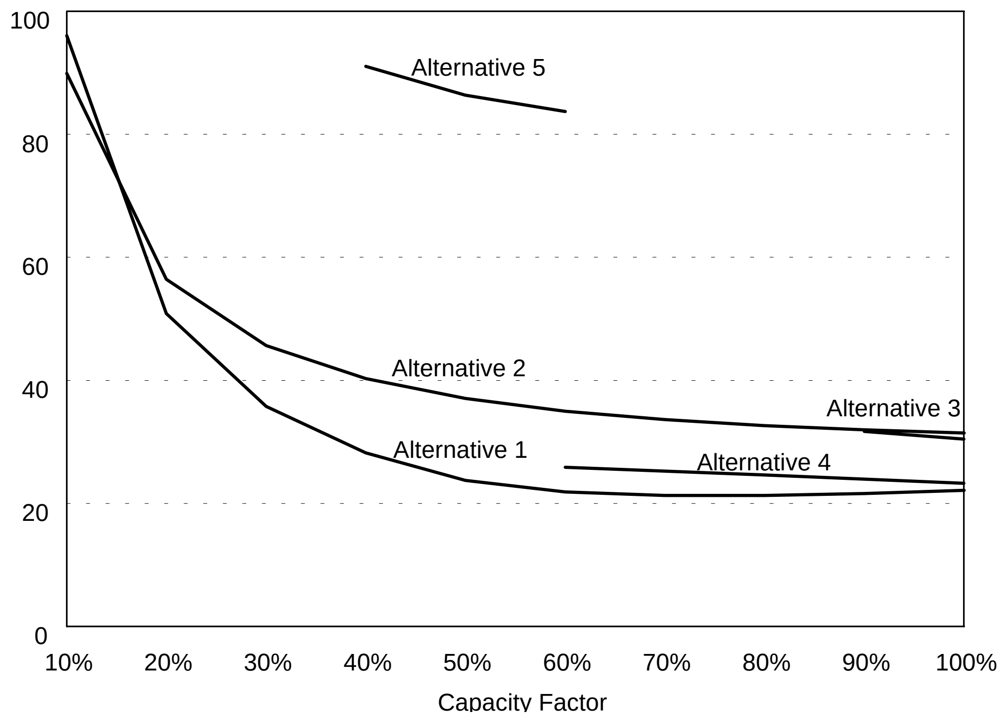
Step 5: Produce a cost curve relating the amount of power available at the lowest cost (based on levelized, per-unit cost).

Cost curves show a visual representation of the interaction of each replacement resource with the interconnected power system. The cost curves below are constructed so that each curve represents the adjusted levelized-cost of a single WRP alternative at various capacity factors.[12]

FIGURE 6-2

COST CURVES

(MILLS/KWH)



6.5 RATE ANALYSIS

Western will recover costs associated with replacement power from the SLCA/IP customers receiving replacement power as WRP on a pass-through cost basis. Rates and charges for WRP will be developed and applied independent of the SLCA/IP rate.[13] The basic SLCA/IP wholesale firm-power rate will be unaffected by WRP, and customers choosing to purchase WRP will continue to purchase SLCA/IP power at the same rate as customers who do not purchase WRP.

The integrated analysis results can be dis-aggregated among various electric systems modeled within the Rocky Mountain/Desert Southwest region. The level of dis-aggregation can be extended to (i) Western, (ii) various groupings of SLCA/IP customers, and (iii) various groupings of other systems. For purposes of the proof-of-concept analysis, the dis-aggregation was made between SLCA/IP customers and other utility systems. This level of dis-aggregation was sufficient to estimate the net expenses that Western would incur for WRP, and therefore the rate that it would have to charge to customers purchasing WRP.[14]

In the table below, an example of a rate analysis is provided based on results for Alternative 1. The actual rates for the WRP purchase are shown in the first section of the table. In the second section of the table, the average pass-through rate for WRP is calculated, based on the total capacity and energy charges that would be incurred by Western for WRP, less the revenues from marketing surplus WRP to other utilities, divided by the total WRP energy scheduled.

TABLE 6-3

SAMPLE RATE ANALYSIS

	1996	1997	1998	1999	2000
WRP Alternative 1					
Charges/Rates:					
Maximum Rate of On-Peak Delivery ($ per KW-Month)	3.50	3.64	3.79	3.94	4.09
All Energy (mills per KWh)	14.00	14.42	14.85	15.30	15.76
Western Scheduled Use and Costs:					
To SLCA/IP Contractors Purchasing WRP					
Maximum Rate of On-Peak Delivery (MW)	491	475	352	366	468
Energy (gWh)	1237.1	899.0	713.1	994.4	1001.5
Annual Costs (000)	$35,695	$28,959	$23,610	$32,131	$35,494
Surplus Sales of WRP to Other Entities					
Maximum Rate of On-Peak Delivery (MW)	0	0	0	0	0
Energy (gWh)	1680.8	1416.8	1140.4	1532.1	1626.1
Net Revenues (000)	$6,803	$7,055	$7,713	$9,842	$12,583
Western Average Pass-Through Rate					
Net Costs (000)	$28,892	$21,904	$15,898	$22,289	$22,910
Energy (gWh)	1237.1	899.0	713.1	994.4	1001.5
Average Per Unit Cost (mills per KWh)	23.35	24.36	22.29	22.41	22.88

The WRP rate charged by Western does not represent the total cost impact to customers. In addition to the effect of rates paid to Western, the operational costs of each SLCA/IP customers' own resources can be affected by the commitment to purchase WRP. In general, these impacts will be positive; that is, there will be additional savings through reduced energy costs and, in some instances, reduced capacity costs. The reverse can occur, however, when a purchase alternative results in forced purchases of WRP due to Western's purchase obligations. These additional cost impacts, while significant, will not affect Western's rates and, therefore, were not considered in the WRP rate calculation. (However, these impacts will be accounted for when Western develops a levelized-cost analysis and cost curves, as they were in the results of the proof-of-concept analysis.)

6.6 SENSITIVITY (RISK) ANALYSIS

As discussed in Section 4.6, the financial risk associated with acquisition of WRP rests with the customers. Financial risk can be classified into four areas: hydrology risk, fuel price risk, load growth risk, and contractual risk. Contractual risk is best addressed through structuring terms and conditions of the purchase as a part of contract negotiations. Western will use sensitivity analyses where necessary to address other areas of risk.

Hydrology risk describes the probability that Western will not be able to fulfill its contractual obligation to supply CROD during any given season, due to the variation in water conditions. Conversely, during favorable water conditions, Western may be able to supply additional hydroelectric power, reducing the need for WRP. As described in Section 4, one way customers may mitigate this risk is by requesting a portfolio of WRP with varying amounts and terms.[15] By examining a range of low, average, and high water conditions in analyses of longer-term purchases, Western can demonstrate the value of various WRP alternatives to the customers under differing future scenarios to assist in these decisions.

For acquisitions of more than five years, Western's evaluation process will address the effects of uncertainty in fuel price and load projections. When appropriate to the circumstances, sensitivity analyses could be examined for these long-term purchases by using a range of future load growth and fuel price scenarios for the utility systems modeled. Fuel price is central to risk analysis and risk mitigation associated with resource alternatives. While price fuel risk can be mitigated through contractual terms, such risk mitigation comes at a cost. The effect of variation in future fuel prices on the value of a WRP alternative can be examined by Western through conducting model evaluations over a range of future fuel prices. Similarly, a range of future load growth for customers, as provided by the customers, can be examined when appropriate to determine the effects of future load growth on the value of the WRP alternatives.

After reviewing the results of all of the analyses described throughout this section, Western will make replacement resource acquisition decisions based on the aggregate purchase amount requested by customers. The sensitivity analysis discussed above, along with the integrated analysis for a range of water conditions for the actual WRP evaluations, will assist Western in what in many cases will be a decision among closely competing alternatives. The non-cost characteristics of resource alternatives will also be considered to further refine the ranking as a tie-breaker to assist further in selecting the winning proposal(s).

6.7 DISCUSSION OF RESULTS

As discussed previously, the purpose of the proof-of-concept analysis was to demonstrate the modeling tools and evaluation methodology, not to prepare an actual evaluation resulting in selection of specific replacement resource alternatives. The hypothetical replacement resources were selected to test the capabilities of the recommended tools to evaluate the wide range of alternatives that Western may encounter during the Replacement Resources Process. The paragraphs which follow summarize the performance of these tools with respect to:

- replacement resource characteristics;
- transmission system transactions;
- the SRP Exchange Agreement; and
- economic dispatch of system resources.

6.7.1 WRP RESOURCE CHARACTERISTICS

The proof-of-concept analysis demonstrated that the evaluation process is capable of differentiating the distinct characteristics of each hypothetical replacement resource, as discussed below.

6.7.1.1 SCHEDULE AND PRICE

The results of the analysis illustrated the interaction of differences in WRP price and scheduling restrictions for the five purchases modeled, as discussed below.

The first two alternatives, involving firm-capacity purchases with associated energy, were priced so that the first alternative had a higher capacity cost and lower energy cost than the second. The levelized cost over the five-year study period was lower for Alternative 2 only at the lowest (10 percent) capacity factor. At higher capacity factors, the increased use of lower cost energy from Alternative 1 offset the higher capacity cost, resulting in Alternative 1 being the lower cost resource overall.

Although Alternative 3 did not have an explicit capacity charge, its energy rate was higher than that for Alternatives 1 and 2. In addition, Alternative 3 had a minimum monthly schedule of 50 percent. The modeling results showed that based on economics, the purchase would not be scheduled at the required 50 percent level. Energy from other lower cost resources was displaced to accommodate the minimum schedule for Alternative 3. The minimum schedule requirement of 60 percent on-peak capacity factor for Alternative 4, the capacity-exchange purchase, also displaced lower cost power to schedule the WRP power (non-economic scheduling).

The wind resource modeled in Alternative 5 showed the economic effects of a non-dispatchable resource. The hourly energy schedule was estimated as the actual output from the project, and was not scheduled based on economics. The combination of high energy cost and a lack of dispatchability resulted in the wind resource being the highest cost alternative.

6.7.1.2 FIRM CAPACITY

An additional difference between the alternatives and the base case was that all of the alternatives provide some degree of assurance of power deliveries during the on-peak period, as opposed to the short-term economy energy purchases assumed in the base case, which offer no guarantee of availability at any given time. The firm-capacity resources (Alternatives 1, 2 and 4) would give Western the ability to schedule the maximum hourly demand in any hour. The cost of this was either the direct capacity cost, or for the capacity exchange, the increased amount of return energy required.

Alternative 3 was assumed to be a firm-energy purchase and, as such, the supplier would not guarantee delivery of the maximum capacity during all peak hours. Western would need to rely on its own resources or purchases from others to provide capacity in hours where the full capacity from this alternative was not available.

Alternative 5, purchase from the wind resource, is non-dispatchable and, like Alternative 3, cannot be considered a firm-capacity resource based on its nameplate capacity. Although the energy produced is dependent on the wind speed during any given hour, some level of reliable capacity can be associated with this power, although it would be significantly lower than the maximum, or even the average, capacity produced. The special characteristics of the wind resource also limit its “capacity factor,” based on the wind profile at the site.[16]

6.7.1.3 LOCATION

Delivery location was varied across the alternatives to illustrate the capability of the model to incorporate the effects of transmission constraints into the economic dispatch of the interconnected system. The alternatives included four different delivery points to Western’s system. (Alternatives 1 and 5 were both delivered at Craig, Colorado, but varied with respect to other resource characteristics.)

The WRP resource location will affect the power flow on Western’s transmission system and over other transmission paths in the WSCC region. An example of this in the proof-of-concept analysis was Alternative 1, which was assumed to be delivered at Craig, and Alternative 2, which was delivered at Pinnacle Peak. Both resources provided approximately the same amount of capacity and energy, but affected power flows differently. The effects of resource location on transactions and power flows between transmission areas is discussed in more detail below.

6.7.2 TRANSMISSION SYSTEM TRANSACTIONS

Although specific transmission improvements were not explicitly modeled as part of the proof-of-concept analysis, the results of the analysis do illustrate how the location of the WRP resource will affect the flow of power on Western's system. In the example of Alternatives 1 and 2 which were assumed to be delivered at Craig and Pinnacle Peak, respectively, the detailed transmission information available from MULTISYM shows that the net flow of energy across TOT2A from north to south was about twice as much in Alternative 1 as in Alternative 2.[17] In addition, Western's defined transmission link was scheduled at the maximum flow approximately half of the hours in the year in Alternative 1 as compared to less than 20 percent of the hours in the year for Alternative 2. These results suggest that relaxing Western's transmission constraint by purchasing transmission capacity from another system or upgrading facilities across TOT2A might improve the economics of Alternative 1.

While MULTISYM can model contractual transmission path constraints and identify the consequent effect on economic dispatch and reliability, traditional power-flow analysis will be necessary to study transmission effects in detail, as discussed in Section 4.3.6.3. During the actual WRP evaluations, Western will examine the results, and identify cases where detailed transmission analysis can be used to identify transmission improvements that would increase Western's transfer capability (in this case across TOT2A). Engineering analysis could then produce cost estimates for potential transmission system additions.

The integrated analysis would then be reanalyzed with the additional transmission capacity available after improvement. Western would then recalculate the levelized cost for Alternative 1 with the transmission improvement including the effects of the change in system economic dispatch, as well as the cost of the upgrades or improvements. This modified levelized cost would then be compared to the levelized costs for the other alternatives to determine the lowest cost WRP resource.

6.7.3 SRP EXCHANGE AGREEMENT

A WRP resource located at Craig could affect the transmission available to SRP under the SRP Exchange Agreement. When Western is not able to provide exchange power, and SRP requires wheeling from Western to wheel power from SRP's allocation from its share of Craig, Hayden, or Four Corner generating units, some of this transmission capacity could be used by the replacement resource. This is illustrated by Alternative 1, in which the WRP resource was assumed to be located at Craig. The amount of power that SRP was projected to schedule from its share of the Craig and Hayden units was reduced in Alternative 1, as compared to Alternative 2. The transmission constraints limited the amount of power that could flow from SRP's Craig and Hayden units to its load in Alternative 1.

Conversely, one of the limiting factors in the amount of energy that can be exchanged as part of the SRP Exchange Agreement is the requirement that sufficient generation must be available at Glen Canyon for Western to serve its Arizona and Southern Utah customers. A WRP resource located near Arizona could potentially provide Western additional power in Arizona and increase the amount of power available to be exchanged.

6.7.4 RESOURCE DISPATCH

6.7.4.1 SLCA/IP RESOURCES

The WRP resource will primarily provide on-peak power to the extent that Western cannot provide it from SLCA/IP resources, including GCD, due to operating restrictions.

Typically, the WRP resource will not affect the way that Western schedules its hydropower; however, Western may modify its hydroelectric schedule to accommodate economy energy transactions using WRP.

6.7.4.2 THERMAL PLANT DISPATCH

The WRP resource can affect the dispatch of thermal resources owned by SLCA/IP customers purchasing or not purchasing WRP, as well as resources owned by other utilities. The minimum scheduling requirements of a WRP purchase can displace lower cost resources. This was illustrated in several of the alternatives evaluated, including Alternative 3. In this example, Alternative 3, which had a 50 percent minimum monthly schedule and an energy cost of 26 mills, displaced other resources owned by SLCA/IP customers with an average energy price of approximately 23 mills. Similar displacement of lower cost SLCA/IP customer resources occurred for Alternatives 4 and 5.

Alternatively, the WRP resource could change the economic dispatch of other thermal resources. To the extent that the WRP energy is priced lower than the system marginal cost, the WRP resource could displace more expensive resources. This was illustrated with Alternative 1 as discussed in Section 6.2.

In addition, a capacity exchange resource where payment is in the form of return energy can affect both the hourly scheduling of resources and the overall level of generation. The on-peak resource schedule would be reduced and the off-peak generation increased to provide return energy.

6.8 FINDINGS

The proof-of-concept analysis demonstrated feasible methods, techniques and tools for Western to use in evaluating and acquiring replacement resources. While the methods identified were demonstrated primarily with power purchases, these same methods and modeling tools will be applicable for analyzing alternatives such as resource lease or build options for longer-term replacement in the future. Additional findings follow:

1. Given the complexities of the purchase and sale transactions in the WSCC bulk power market, a tool such as the MULTISYM production cost model is essential for accurately modeling the interaction of potential replacement resources with the interconnected system. The MULTISYM model, as implemented for the proof-of-concept analysis, also accounts for:
   - the effect of existing transmission system constraints on replacement resource alternatives and their operation in the interconnected system, including the ability to modify transmission constraints to examine “what-if” scenarios;
   - the interaction of replacement resources within the interconnected system;
   - the modeling of a wide variety of power purchase pricing structures, scheduling restrictions, delivery locations, and other characteristics such as dispatchability and reliability;
   - non-firm purchase and sales opportunities and transactions, from both existing resources and replacement power resources;
   - the displacement of generation from other resources by replacement power; and
   - varying levels of customer participation in specific replacement resource alternatives.
2. Although specific transmission improvements were not explicitly modeled as part of the proof of concept analysis, the results of the analysis do illustrate how the location of the WRP resource will affect the flow of power on Western’s system. While MULTISYM can model contractual transmission path constraints and identify their affect on economic dispatch and reliability, traditional power-flow analysis will be necessary to study transmission effects in detail.
3. Appropriate sources for interconnected system load and resource data were identified and tested, and will be

appropriate for Western to use in maintaining a current database to use in evaluating replacement resources.

4. Data gathering and implementation resulted in a useable database for Western as a starting point for actual evaluations. The models developed during the proof-of-concept analysis are in a relatively advanced stage of implementation, reducing the amount of additional work for Western prior to performing actual replacement resource evaluations.

ENDNOTES:

[1] For each year, this would normally involve 8,760 hourly simulations of a very complex system. The model was further simplified for the proof-of-concept analysis to represent one typical week for each month. For the base case and first WRP alternative, this still involved a total of over 10,000 hours simulated (168 hours per week x 1 week per month x 12 months per year x 5 years). For the remaining four WRP alternatives, the two years simulated resulted in over 4,000 hourly simulations.

[2] The analysis did not attempt to demonstrate Western's ultimate decision-making process, which would result in the selection of a particular replacement resource alternative or combination of alternatives.

[3] For example, the costs associated with the 50 percent minimum energy schedule for Alternative 3 were treated as a fixed costs, because SLCA/IP customers would be required to pay for that amount of energy regardless of whether it was scheduled or not. Similarly, all of the energy costs of Alternative 5 were assumed to be fixed because of the non-dispatchable nature of the wind resource.

[4] The change in the operation of other utility resources represents a combination of (i) economy sales by Western of surplus WRP (not used by SLCA/IP customers), (ii) economy sales by SLCA/IP customers from resources displaced by WRP, and (iii) reduced economy energy sales from other utility resources to SLCA/IP customers because of energy displaced by "forced" sales of WRP to meet minimum purchase obligations or accommodate energy from a non-dispatchable resource.

[5] As compared to the base case in 1996, the projected generation from non-SLCA/IP resources in Alternative 1 was reduced by approximately 1,680 gWh, with an associated decremental cost of approximately 22.1 mills per kWh. This represented a savings of approximately 8.1 mills per kWh, or $13,600,000. These savings were assumed to be split 50/50 between SLCA/IP customers and other utilities. A similar calculation was used to estimate the split savings for Alternative 2.

[6] For the proof-of-concept analysis, these sales were assumed to take place at 85 percent of the decremental cost of the resources affected. For example, Alternative 5 (the wind project) was estimated to displace approximately 271 gWh of energy from other utility-owned resources with an associated decremental cost of 23.1 mills per kWh. The other utilities were assumed to pay SLCA/IP customers 85 percent of the decremental cost or 19.7 mills per kWh for this power for a total cost of approximately $5,331,000. This represents the revenues the SLCA/IP customers would receive. Similar calculations were used to determine the SLCA/IP customer and other utility estimated split the savings for Alternative 3 and Alternative 4.

[7] In this case, the marginal energy cost of the particular IOU was projected to increase slightly more than the average increase in non-firm energy costs system-wide; hence the decrease in economics compared to the base case.

[8] The non-firm market was represented with a five block pricing structure in which each block is assigned a price and a corresponding percent of total non-firm energy. For the proof-of-concept analysis, representative prices were estimated based on current market conditions.

[9] The results of the integrated analysis were used to better estimate the net reduction in the levelized per-unit costs of each alternative due to sales to other utility systems. These energy sales to other utility systems would occur primarily during the off-peak but could also occur during the on-peak period.

To be conservative, the per-unit credit derived at the specific peak-period capacity factor from the integrated analysis was assumed to be the maximum credit in refining the screening analysis. For peak-period WRP capacity factors greater than the capacity factors projected in the integrated analysis, the per-unit credit was reduced proportionately, so that at a 100 percent peak-period capacity factor the per-unit credit was reduced to a small fraction of the maximum per-unit credit. The proportionate reduction was made in order to approximate the reduction in WRP energy available for sale to other utilities when SLCA/IP customers make more intensive use of WRP during the peak period. For example, if the per-unit credit from the integrated analysis was 4.5 mills/kWh associated with a 55 percent peak-period capacity factor, the per-unit credit was not increased at a 50 percent peak-period capacity factor. Although, arguably, a reduction in WRP scheduled to SLCA/IP customers represented by a lower peak-period capacity factor would result in more WRP available for non-firm sales, there is no guarantee there would be opportunity for additional, economical non-firm sales.

[10] Comparing the results of the initial screening analysis and the adjusted levelized-cost analysis demonstrates how the economic ranking of the alternatives can change through use of the more accurate cost estimates obtained from the integrated analysis. In the screening analysis, Alternative 2 had the lowest costs up to a 30 percent capacity factor. The results of the adjusted levelized-cost analysis changed this ranking, and Alternative 1 is now the lowest cost resource at a 20 percent capacity factor. Also, the screening analysis indicated that Alternative 4 has the lowest cost at a capacity factor of 60 percent or greater. This changed in the integrated analysis, with Alternative 1 becoming the lowest cost option at a capacity factor of 60 percent or greater. Although Alternative 5 is the highest cost resource in both analyses, the integrated analysis in which the actual hourly interaction of this non-dispatchable resource is captured, results in a significant increase in the cost of this alternative.

[11] For example, the results from the integrated analysis show that Alternative 4 provided the lowest costs in the first year (1996), while Alternative 1 had the lowest costs over the five-year period. Therefore, Alternative 1 was the lowest cost resource for a five-year purchase, while Alternative 4 would be the lowest cost resource for a single year purchase in 1996.

[12] Only those alternatives which operate at particular capacity factors shown are included in the curves. (For example, only two cost curves are shown at 30 percent capacity factor and below, because only two alternatives operate at 30 percent capacity factor or below.)

[13] As described in Section 4.3.5.1, separate cost “pools” are assumed to be established for expenses associated with specific purchases of WRP, which will include both the direct and indirect costs associated with Western’s purchase and delivery of WRP. In addition, the cost pool will be reduced by any revenue gained from Western’s marketing surplus WRP to others or, if economical, use of surplus WRP to meet Western’s firming energy requirements for its

SLCA/IP commitments. The net revenues derived from these sales will be applied as a credit to the appropriate cost pool.

[14] As discussed in Section 6.2, Western may dis-aggregate the results further in cases when some SLCA/IP customers choose not to participate in WRP.

[15] See the discussion of this portfolio approach in Section 4.2.2.

[16] One possibility would be to firm the capacity of this resource by adding low-capital cost backup generation However, this would significantly increase the cost of this alternative, which was already the highest cost resource over the five-year period. Construction of <u>any</u> type of generation, including backup generation at a wind resource site, would not be likely to be economical over a short period such as five years. The capacity for renewable resource alternatives (and therefore any firming judged to be necessary by Western depending on the circumstances) will depend on a number of factors including the treatment of the specific project by the Inland Power Pool.

[17] TOT2A is the constrained transmission path connecting the Southwest corner of Colorado and the Northwest corner of New Mexico.